



# **STATE OF CALIFORNIA**

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## **DEPARTMENT of TRANSPORTATION**

### **MATERIALS ENGINEERING AND TESTING SERVICES**

#### **OFFICE OF RIGID PAVEMENTS and STRUCTURAL CONCRETE**

**5900 Folsom Boulevard  
Sacramento, California 95819**



**Interstate 405  
PM 2.9 to PM 9.0**

## **DOWEL BAR RETROFIT EVALUATION**

### **PRELIMINARY REPORT**

**DISTRICT 12  
Orange County  
Interstate 405  
Contract Number: 12-0A1104**

**September 2001**

## **ACKNOWLEDGEMENTS**

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### **Headquarters**

**Division of Maintenance**

### **District 12**

**Maintenance**

**Construction**

### **Industry**

**Penhall Company**

**Western States Chapter  
American Concrete Pavement Association**

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**Cover Photo:** Typical dowel bar retrofit in a skewed joint on Interstate 405 in Orange County, California

**DOWEL BAR RETROFIT EVALUATION**  
**District 12**  
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This report reflects the observations, findings, conclusions, and recommendations of the authors. The contents do not necessarily reflect the official views or policies of the State of California.

This report does not constitute a standard, specification, or regulation. The Office of Rigid Pavement and Structural Concrete is responsible for the accuracy of the information and data presented in this report.

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## **SUMMARY**

A dowel bar retrofit project in District 12 on Interstate 405 (I-405), near Irvine in Orange County, began to exhibit signs of failure in the bond between the existing concrete and the backfill grout in the dowel bar slots. The project is between Sand Canyon Overcrossing and the I-405 / Route 55 separation. Recent counts show that this segment is subjected to an Annual Average Daily Traffic (AADT) from 196,000 to 275,000.



**Figure 1.** Project Location

The Headquarters HA-22 Program Advisor expressed concerns over the loss of backfill grout in dowel bar retrofit slots. It was requested that the Office of Rigid Pavement and Structural Concrete evaluate the failing dowel bar installations and make recommendations.

Two on-site visits were made to assess the present status of the installations. The initial visit was on May 10, 2001, and a second visit on May 15, 2001. Samples were taken during the second site visit.

Data and information were obtained from the following sources:

- a. Project plans
- b. Observations during the on-site visits.
- c. Examination of the samples

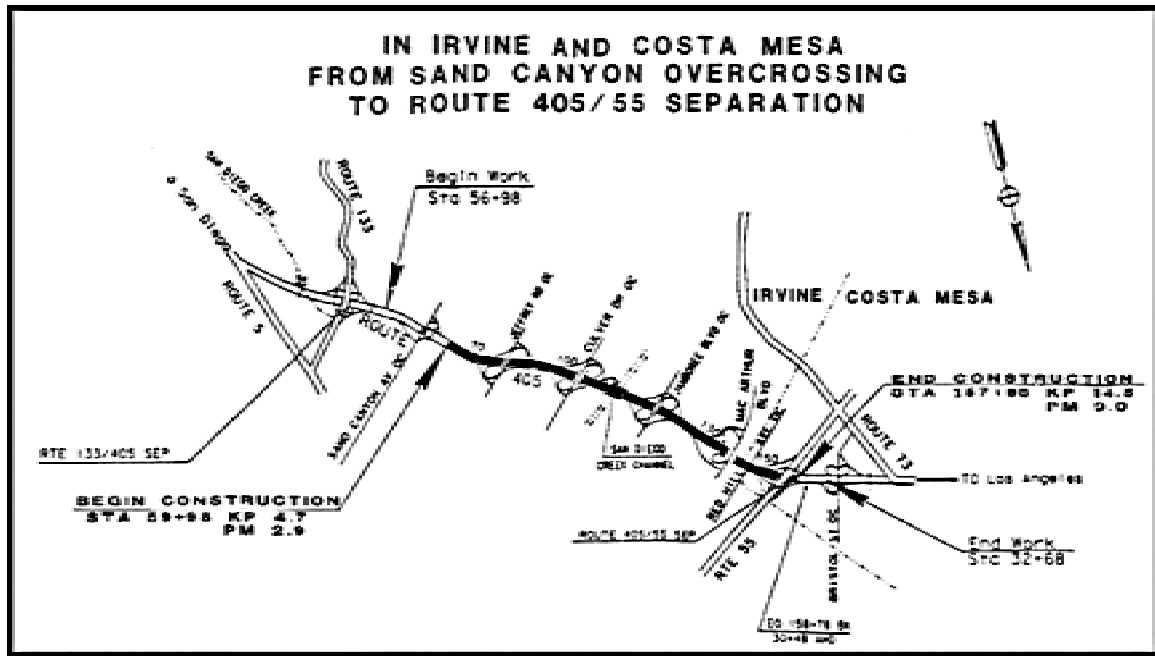
This investigation focused primarily on the pavement distresses observed and testing of the samples.

The site inspection revealed a number of the dowel bar installations throughout the retrofitted segment had failed. Among the conditions were:

1. The backfill grout had fragmented and dislodged from the dowel bar slots.
2. Dowel bars appear to have been placed too close to the pavement surface
3. Foam boards were not aligned with existing transverse joints.
4. Sealant was not applied in the transverse joint

## **PROJECT DESCRIPTION**

This project rehabilitated a 9.8-km long segment of I-405 by retrofitting the existing panels of lane 4 and grinding sections of the existing pavement in lanes 3 and 4. The project limits extended from 0.1-km north of the Sand Canyon Over-crossing (sta.59+98) to 0.5-km north of the I-405 / Route 55 separation (sta. 157+98).



### Figure 2. Project Limits

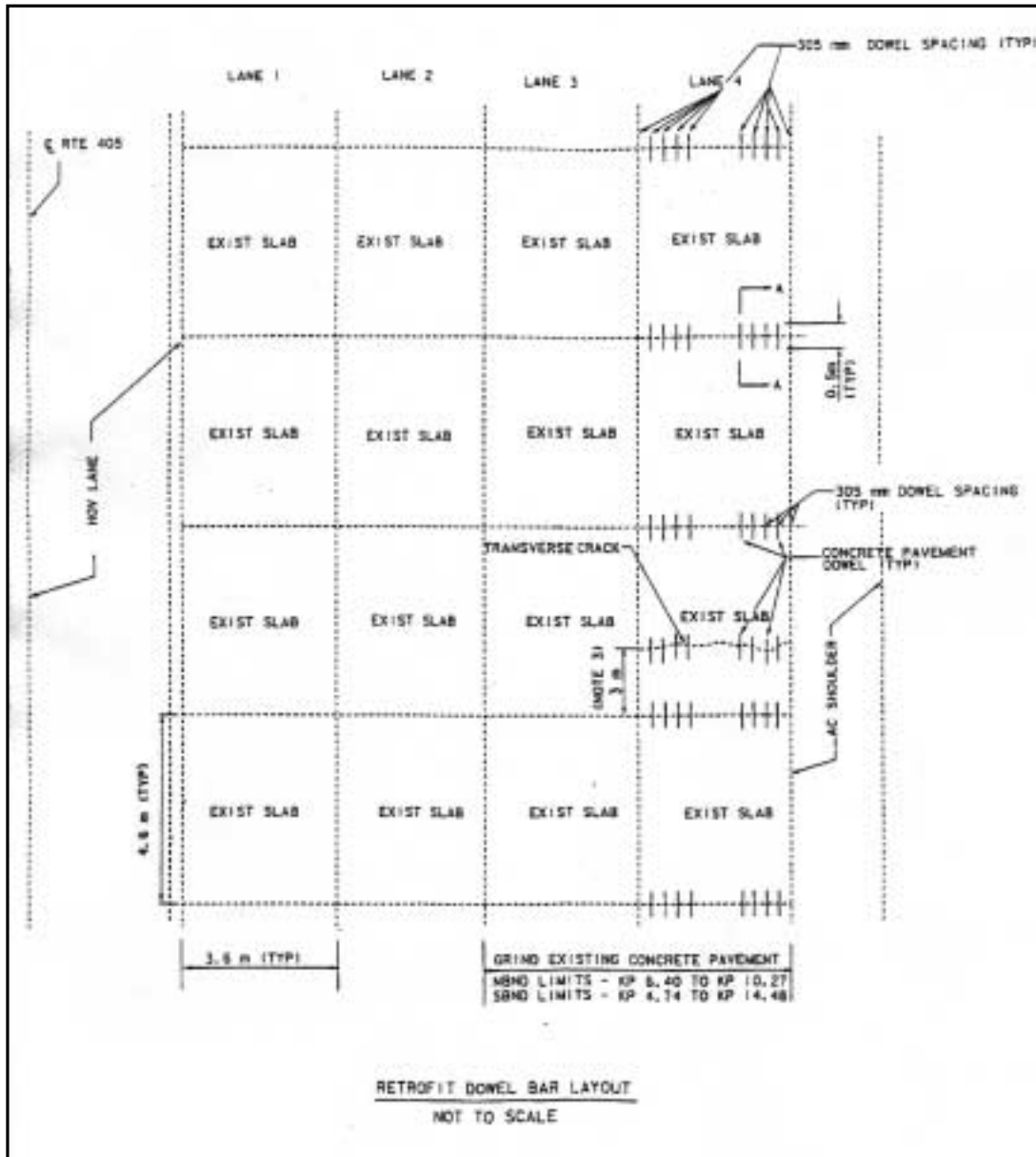
## Construction Details

The rehabilitation project was completed in November 1999. The limits for the dowel bar retrofit and grinding of the existing pavement were from station 76+50 to station 115+10 in the northbound direction and from station 59+98 to station 157+67 in the southbound direction (see Figure 3).

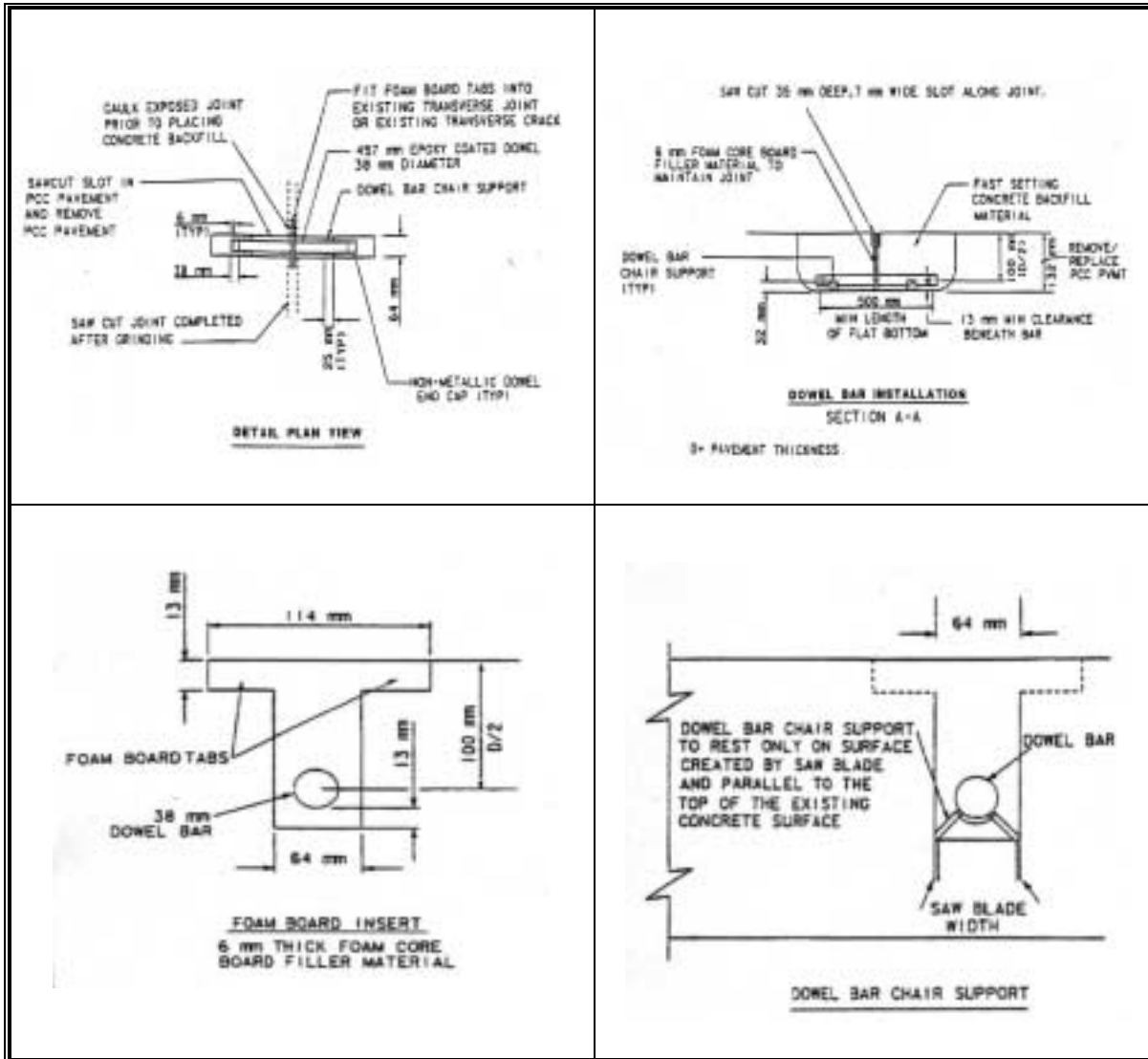
The retrofit required that dowel bars be installed in the transverse joints, transverse cracks, and diagonal transverse cracks in the existing panels on lane 4. Only cracks that were 3-m from the transverse joint or adjacent crack were retrofitted.

Dowel bars were installed by saw-cutting slots parallel to the direction of traffic in the existing pavement. A dowel bar with a foam board insert and chair supports was placed in each slot. The slots were then back filled with fast setting concrete (see Figure 4).

The dowel bars specified were 457-mm long, 38-mm diameter epoxy-coated smooth bars evenly spaced at 305-mm intervals, in the inner and outer wheel paths of the lane.



**Figure 3.** Dowel Bar Retrofit Plan



**Figure 4.** Dowel Bar Retrofit Details

**INSPECTION TEAM**

Pavement inspections were performed by:

**Office of Rigid Pavement and Structural Concrete**

Doran Glauz	Senior Materials & Research Engineer
Karl Smith	Maintenance Manager I
Raul Alarcon	Transportation Engineer

**District 12 - Maintenance**

Massoud Tajik	Branch Chief
Majid Movahed	Transportation Engineer
Keith Samson	Area Superintendent

**District 12 - Construction**

Dan DeBassio	Assistant Resident Engineer
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**Headquarters**

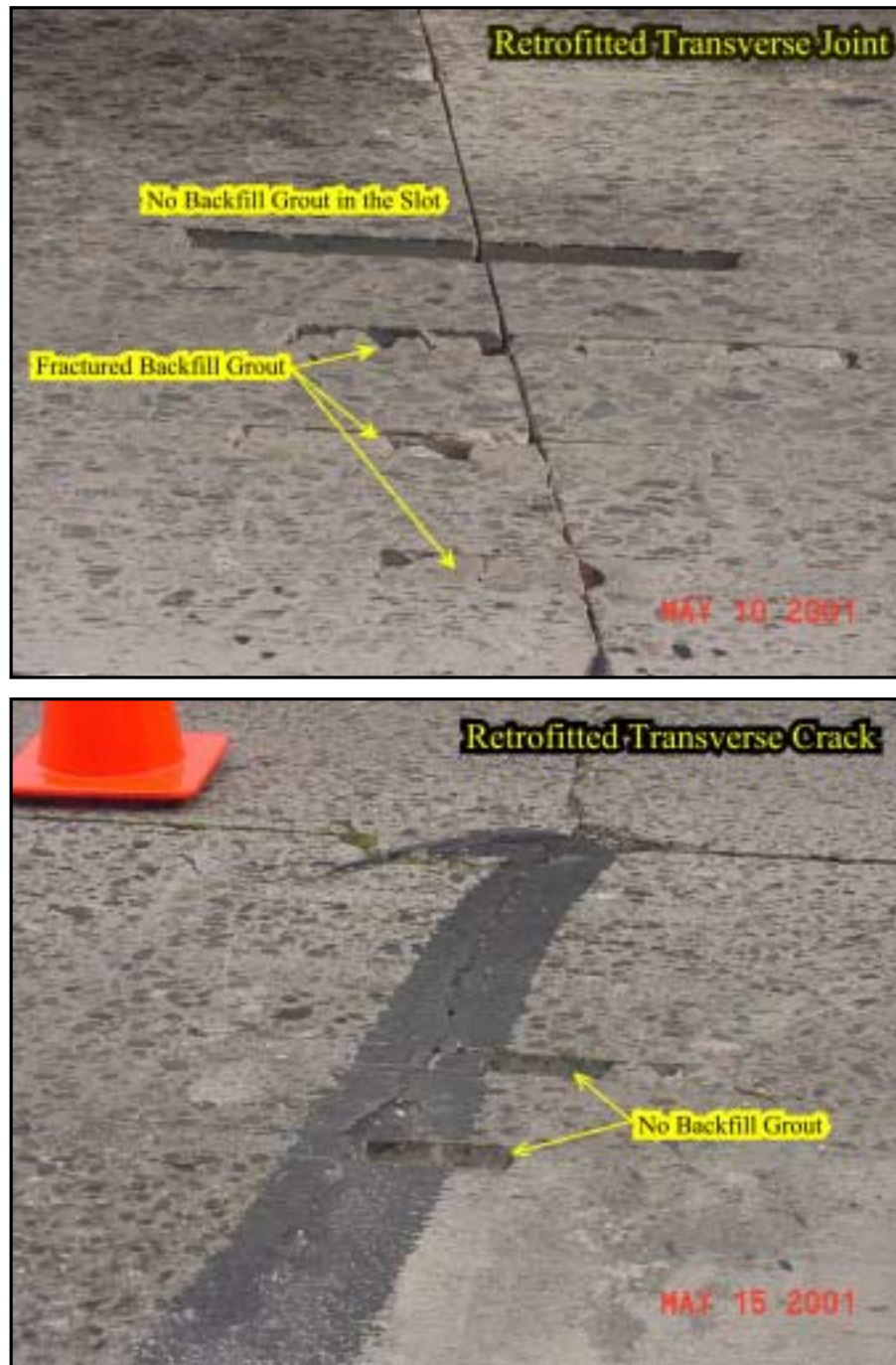
Leo Mahserelli	HA22 Program Advisor
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**Industry**

Casey Halloway	Penhall Company
Tom Salata	American Concrete Pavement Association (Western States)

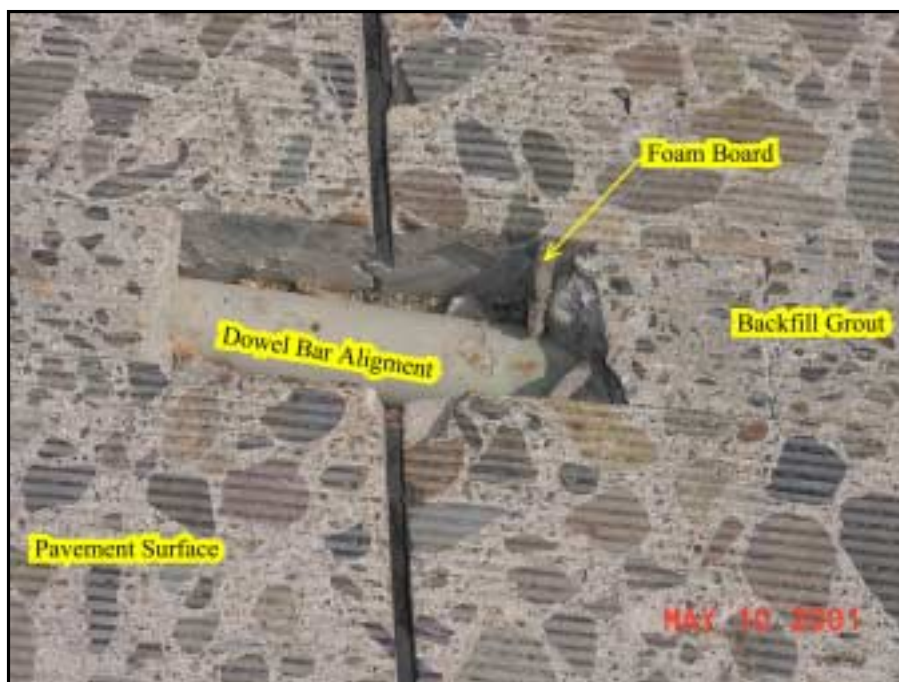
**FIELD OBSERVATIONS**

Pavement inspections were performed on Thursday, May 10, 2001 and May 15, 2001. Several panels along the retrofitted segment were examined. The backfill grout at some dowel bar installations was fractured and loose in the slot. At other locations, the backfill was missing completely, exposing the dowel bar.



**Figure 5.** Loose Backfill Grout

At locations where the grout was missing, it could be seen that the bond between the grout and pavement had failed. The exposed dowel bars appear to be too close to the pavement surface and vertically misaligned.



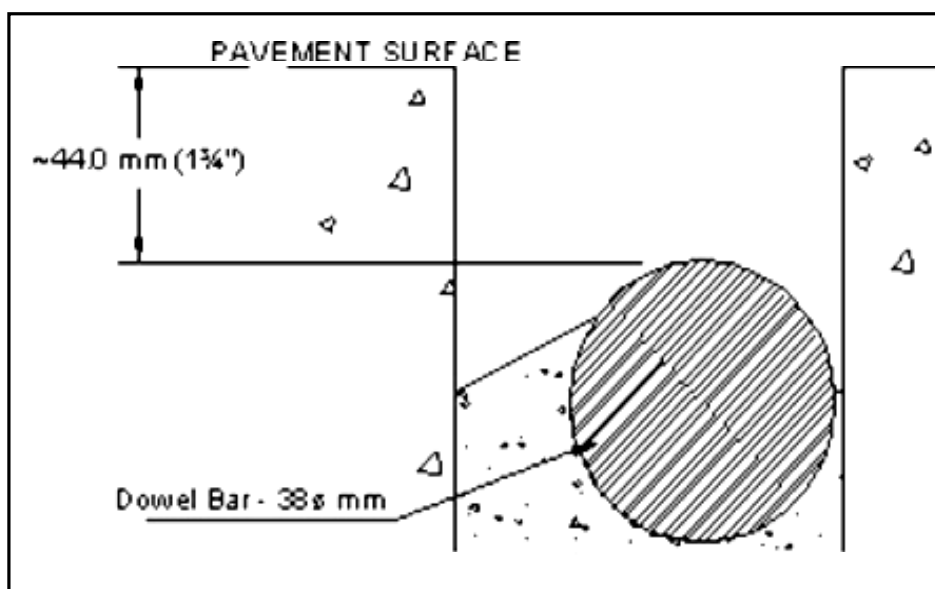
**Figure 6.** Exposed Dowel Bars

Foam boards were not aligned with the existing transverse joint. The joints were not filled with backer rod and joint sealant.



**Figure 7.** Foam Board Alignment

A closer examination of an exposed dowel bar at the transverse crack revealed that the dowel bar was approximately 44-mm (1¾-in.) from the pavement surface and is not centered in the slot.



**Figure 8.** Dowel Bar Placement

**TEST SAMPLES**

The dowel bar installations, shown in Figure 9, were removed from a retrofitted transverse crack in the northbound section of the project. Each of the three samples is about 1 m long, 0.3 m wide, and the full depth of the pavement.



**Figure 9.** Retrofitted Transverse Crack



**Figure 10.** Samples 1 and 2 removed from Transverse Crack

The samples will be tested to evaluate the backfill grout, placement/alignment of the dowel bars, and depth of the slot.

## **CONCLUSIONS**

### **Dowel Bar Retrofit**

The inspected dowel bars did not conform to the positioning requirements specified in the project plans. The center of the dowel bars should be 100 mm below the surface of the 200 mm thick pavement.

## **RECOMMENDATIONS**

In order to affectively provide load transfer, the dowel bars should be placed in accordance with the project plans and specifications.

Samples will be evaluated in the laboratory. Evaluations will include measurements, radiographic imaging, strength testing, and grout composition.

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